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| 10/051,183 | 01/22/2002 | Otto Z. Zhou | 032566-017 | 9917 |

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| EXAMINER | |
|---|---|
| SONG, HOON K | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2882 | |

DATE MAILED: 04/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Applicati n No. | Applicant(s) | |
|---|---|---|---|
| | 10/051,183 | ZHOU ET AL. | |
| | Examiner | Art Unit | |
| | Hoon Song | 2882 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *12 January 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *2-10,12-23 and 26-74* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-10,12-23 and 26-74* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 January 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

**Claims 2-6, 12-23, 26-28, 30-32, 44, 60-61 and 65-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock et al. (US 6333968B1) in view of Keesmannn et al. (US 5773921).**

Regarding claims 2, 12, 26 and 27, Whitlock teaches a system to generate and detect x-rays comprising:

a cathode structure having a plurality of individually electrically addressable field emissive electron sources defining a plurality of cathodes, each cathode disposed on a first side of the cathode structure (figure 2f);

a target structure (figure 3);

a evacuated chamber that houses the plurality of cathodes and the at least one target (figure 2a);

wherein the electron sources are field emission electron sources (figure 2f),

wherein each electron field emission source is triod-type comprising a field emissive material and a gate electrode positioned parallel to and insulated from a substrate (figure 2f),

wherein a plurality of electrons are filed emitted from the cathode when the electric field between the gate electrode and the filed emissive material exceed a threshold value,

wherein the plurality of field emitted electrons pass the gate electrode and are further accelerated to impact on the at least one target by an electric filed applied between the gate electrode and the at least one target,

wherein, upon impact, at an incident point, at least one x-ray having a characteristic wavelength corresponding to a material of the at least one target and at least one x-ray having a continuous wave length are generated and

an object; and

a detector structure to receive and detect an x-ray from the target,

wherein each cathode comprises a substrate and a gate electrode positioned parallel to and insulated from the substrate, the substrate comprising a field emissive material.

However Whitlock fails to teach that the target structure has deflection surface nor a object positioner nor claimed field emissive cathodes.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide x-ray system of Whitlock with know deflection target since the deflection target would provide directional x-ray beam to prevent direct illumination of x-ray beam into unwanted part of the x-ray source.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide x-ray system of Whitlock with known object positioner since the positioner would provide better image result by stabilizing the object.

Keesmann teaches a x-ray source having filed emissive material is selected from the group consisting of single walled carbon nanotubes, double walled carbon nanotubes, multi-wall carbon nanotubes, nanotubes comprising at least one non-carbon element, or a nanorod/nanowire comprising at least one of a metal, a metal oxide, silicon, silicon carbide, silicon oxide, carbon nitride, boron nitride, boron carbide, or a chalcogenide.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the imaging system of Whitlick with the field emitter type x-ray source as taught by Keesmann, since the Keesmann's cathodes type would provide high electron emission efficiency and longer lifetime (column 3 line 2+).

Regarding claim 3, Keesmannn teaches that each of the plurality of cathodes is a recessed well in the cathode structure and into which the substrate is disposed, and the gate electrode is disposed across the surface of the substrate substantially equidistant from the substrate (figure 3).

Regarding claim 4, Keesmannn teaches that the plurality of cathodes are each individually positioned on the first surface of the cathode structure at a predetermined interval (figure 5).

Regarding claim 5, Whitlock as modified by Keesmannn fails to teach that the predetermined interval is approximately 10° to 120°.

However, while none of theses is explicitly set forth, all of these are clearly within the level of ordinary skill in the art to use and would have been obvious to one of ordinary skill in the art to employ absent any showing of criticality based solely on design choice. Thus it would provide sufficient resolution of x-ray positions to radiate without missing any field of views.

Regarding claim 6, Whitlock teaches that the target is an area array of target material or a plurality of individual target material (figure 3).

Regarding claim 13, Whitlock as modified by Keesmann fails to teach that the predetermined frequency is in the range of 0.1 Hz to 100 kHz.

However It would have been obvious to one having ordinary skill in the art at the time the invention was made to have the claimed frequency, since it would provide sufficiently rapid radiation for imaging an object.

Regarding claim 14, Whitlock teaches that the predetermined frequency is sufficiently rapid to dynamically image a physiological function.

Regarding claim 15, Whitlock teaches that the electron is non-divergent and accelerated from a field emissive material toward a gate electrode and impacts the target at an incidence point (figure 3).

Regarding claims 16-19, Whitlock fails to teach that the step of emitting an x-ray forms a pencil-like x-ray beam, the x-ray beam corresponding to one or more pixels or lines of pixel of a detecting means utilized in the step of detecting.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide x-ray source of Whitlock as modified by Keesmann with known x-

ray beam type since pencil beam would provide more accurate imaging results by preventing scattered x-rays.

Regarding claims 20-21, Whitlock fails to teach that the step of emitting an x-ray forms a cone-like x-ray beam, the x-ray beam corresponding to an area of no more than 128x128 square pixels of a detecting means utilized in the step of detecting.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide x-ray source of Whitlock as modified by Keesmann with known x-ray beam type since cone beam would provide more broad imaging filed so that would reduce mechanical movement of imaging system.

Regarding claim 22, Whitlock teaches that a detecting means used in the step of detecting is a charge-coupled device.

Regarding claim 23, Whitlock teaches that a step of transferring a detected image resulting from the step of detecting to a computer storage device and refreshing a detecting means for a next image.

Regarding claim 28, Keesmann teaches that the field emissive material is coated on the substrate as a film, is embedded in a matrix of the substrate, or is a free standing substrate structure, and the gate electrode is disposed across a surface of the substrate substantially equidistant from the substrate.

Regarding claim 30, Whitlock teaches that the plurality of cathodes and the at least one target are each on an opposing plane and the target has a deflection surface that is oriented toward a surface of the plurality of cathodes that emits electrons.

Regarding claim 31, Whitlock as modified by the known target teaches that the deflection surface is oriented non-parallel to the surface of the plurality of cathodes.

Regarding claim 32, Whitlock teaches that each of the plurality of cathodes are individually positioned on one of the opposing planes at a pre-determined interval.

Regarding claim 44, Whitlock teaches the power is applied to a subset of the plurality of cathodes sequentially at a preset or variable set frequency

Regarding claims 60 and 65-66, Whitlock teaches the cathodes structure is stationary within the system (figure 3).

Regarding claims 61, Whitlock teaches that the field emissive electron sources are stationary within the system (figure 3).

**Claims 2-10, 27, 29, 33-38, 40-43, 45-59, 62-64, 67-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burke et al. (US 5305363) in view of Keesmann et al. (US 5773921).**

Regarding claims 2, 27, 33, 36, 41-42, 46, 48 and 54, Burke teaches a system to generate and detect x-rays comprising:

an x-ray source having a cathode (figure 2);

the plurality of cathodes are disposed on a face of a first planar surface, at least one targeted disposed on a second planar surface a deflection surface of the second planar surface opposing the face of the first planar surface (figures 3 and 4)

a target structure (10) having a deflection facing the first side of the cathode structure, the deflection surface defining a target;

an evacuated chamber that houses the cathodes and the at least one target (figure 3);

an object positioner (176) disposed within an imaging zone; and

a detector structure (132) to receive and detect an x-ray from the target,

the detector substantially parallel to and at equal distance to the x-ray source and object positioner placed between the x-ray source and the detector (figure 2).

applying power to at least one of the plurality of cathodes to generate x-ray radiation for a preset exposure time (figure 2);

exposing the object to the x-ray radiation (figure 1); and

capturing an x-ray image corresponding to the object by either the x-ray detector or the x-ray sensitive film (figure 1),

However Burke fails to teach that the cathode is the claimed field emitter cathodes.

Keesmannn teaches field emitter cathode used in an x-ray source comprising:

a cathode structure having a plurality of individually electrically addressable field emissive electron sources defining a plurality of cathodes, each cathode disposed on a first side of the cathode structure;

wherein each cathode comprises a substrate and a gate electrode positioned parallel to and insulated from the substrate, the substrate comprising a field emissive material,

wherein the filed emissive material is selected from the group consisting of single walled carbon nanotubes, double walled carbon nanotubes, multi-wall carbon

nanotubes, nanotubes comprising at least one non-carbon element, or a nanorod/nanowire comprising at least one of a metal, a metal oxide, silicon, silicon carbide, silicon oxide, carbon nitride, boron nitride, boron carbide, or a chalcogenide.

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the imaging system of Burke with the field emitter type x-ray source as taught by Keesmann, since the field emitter type x-ray source of Keesmann would provide high electron emission efficiency and longer lifetime (column 3 line 2+).

Regarding claim 3, Keesmannn teaches that each of the plurality of cathodes is a recessed well in the cathode structure and into which the substrate is disposed, and the gate electrode is disposed across the surface of the substrate substantially equidistant from the substrate (figure 3).

Regarding claim 4, Keesmannn teaches that the plurality of cathodes are each individually positioned on the first surface of the cathode structure at a predetermined interval (figure 5).

Regarding claim 5, Burke as modified by Keesmannn fails to teach that the predetermined interval is approximately 10° to 120°.

However, while none of theses is explicitly set forth, all of these are clearly within the level of ordinary skill in the art to use and would have been obvious to one of ordinary skill in the art to employ absent any showing of criticality based solely on design choice. Thus it would provide sufficient resolution of x-ray positions to radiate without missing any field of views.

Regarding claim 6, Burke teaches that the target (10) is an area array of target material or a plurality of individual target material (figure 3).

Regarding claim 7, Burke teaches an evacuated chamber substantially in the form of a hollow cylinder having an inner wall and an outer wall and adapted to position an object to be imaged by the structure within the imaging zone (figure 3).

Regarding claim 8, Burke teaches that a plurality of collimating windows disposed in the inner wall (figure 2).

Regarding claim 9, Burke teaches that the target is an area array of individual target material or a line array of target material (figure 3).

Regarding claims 10 and 41 and 46 53 58, Burke fails to teach that the detector is a charged-coupled device.

However one having ordinary skill in the art would be motivated to adapt known CCD detector since CCD would provide higher image resolution.

Regarding claims 29, 51, Burke teaches an evacuated chamber with a plurality of x-ray transparent windows, each window positioned to allow the passage of at least one x-ray beam generated by a plurality of electrons from a corresponding one of the plurality of cathodes, wherein the plurality of cathodes and the at least one target are disposed within the evacuated chamber and the evacuated cahmber is operationally maintained at a preussure lower than $10^{-3}$ Torr (figure 7)

Regarding claim 34, Burke teaches that the deflection surface is oriented non-parallel to the surface of the plurality of cathodes (figure 2).

Regarding claims 35 and 38, Burke teaches that each of the plurality of cathodes are individually positioned on one of the first or second rings at a pre-determined interval (figure 4).

Regarding claim 37, Burke teaches that the deflection surface is oriented substantially parallel to the face of the plurality of the cathodes that emits electrons

Regarding claims 40 and 52, Burke teaches that the object positioner is movable with respect the x-ray source (figure 1).

Regarding claims 43 and 55, Burke teaches that the power is applied to all of the plurality of cathodes simultaneously (column 6 line 35+).

Regarding claims 45 and 57, Burke teaches that moving or activating the x-ray detectors or the x-ray sensitive films at a corresponding frequency to the preset or variable set frequency to capture the x-ray image.

Regarding claim 47 and 59, Burke teaches that a step of transferring a detected image resulting from the step of detecting to a computer storage device and refreshing a detecting means for a next image.

Regarding claim 49, Burke teaches that the first and second ring are concentric (figure 2).

Regarding claim 56, Burke teaches that the power is applied to a subset of the plurality of cathodes sequentially at a preset or variable set frequency (column 10 line 46+).

Regarding claim 62, 64, 68, 70,72 and 74, Whitlock teaches that the CCD device is stationarily positioned to detect the x-ray (figure 3).

Regarding claims 63, 67, 69, 71 and 73 Whitlock teaches the cathode structure is stationary with respect to the target structure.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoon Song whose telephone number is (571) 272-2494. The examiner can normally be reached on 8:30 AM - 5 PM, Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Glick can be reached on (571) 272 - 2490. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DAVID V. BRUCE
PRIMARY EXAMINER

HKS 4/15/04